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The FE-M Task Force: 3D modelling of THM repository induced effects in the Full-scale Emplacement Experiment (FE) – Mont Terri Rock Laboratory. Current status and the path forward.

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The construction and operational phases of a deep geological repository imply potential perturbations of the host rock, so-called Repository Induced Effects (RIE). Amongst them, spent fuel and high level waste (SF/HLW) produce decay heat even after long times of cooling, which may impair the long-term safety of the Engineered Barrier System and of the geological barrier. The Opalinus Clay (OPA), is currently being assessed as host rock for the deep geological repository in Switzerland. OPA is an indurated clay of Jurassic age (ca. 180 My), whose main features are (1) a very low hydraulic conductivity, (2) an excellent retention capacity for dissolved radionuclides, and (3) a significant self-sealing capacity.

The on-going Full-scale Emplacement (FE) Experiment at the Mont Terri Underground Rock Laboratory simulates, as realistically as possible, the construction, waste emplacement, backfilling and early-stage post-closure evolution of a single SF/HLW emplacement tunnel in OPA, using heaters instead of disposal canisters. The main goal of the FE experiment is the investigation of RIE on the host rock (and, to a lesser extent, on the the backfill material) at true scale and the validation of existing coupled thermo-hydro-mechanical (THM) models. In this context, Nagra has developed a new RD&D initiative, i.e., the FE modelling Task Force (FE-M TF), which involves three modelling teams with corresponding software packages (Code Aster, Code Bright and OpenGeoSys). So far, the TF has defined three main tasks:

- Code comparison and calculation verification: the TF designed a simplified (though realistic) 3D conceptual model of the FE experiment that includes the actual geometry of the main elements, materials and phases of the FE experiment, including tunnel excavation and ventilation. Such conceptual model was implemented by the modelling teams. Finally, code outputs were analysed and compared by the TF.
- Back-analyses of THM-observations in the host rock: monitoring data from radial and oblique boreholes around the backfilled FE tunnel are used for model calibration, including the derivation of parameter best estimates and inherent uncertainties, and model
- Model validation in the context of a prediction-evaluation exercise: the evolution of the THM conditions in the rock in response to a change of thermal loads (e.g., increase/decrease of heater output) will be predicted using the calibrated models. Finally, model predictions will be validated in the near future using the acquired measurements.

This presentation summarizes the current status of Tasks 1 and 2 and the path forward to Task 3.